It is claimed:

1. A phase detector for generating a phase error signal indicative of a phase difference between a reference signal and an oscillator signal, comprising:

an amplifier to convert said reference signal to a substantially square wave signal; and

a sampling phase detector to generate said phase error signal from said substantially square-wave signal and said oscillator signal.

2. The phase detector of claim 1, wherein said amplifier comprises a saturated amplification stage.

3. The phase detector of claim 1, wherein said amplifier comprises a first saturated amplification stage and a second saturated power amplification stage.

4. The phase detector of claim 1, further comprising a transformer to convert a single output of said amplifier to a balanced output.

5. The phase detector of claim 4, wherein said balanced output have impedances that substantially match the respective input impedances of said sampling phase detector.

6. The phase detector of claim 1, wherein said amplifier comprises balanced outputs.

7. The phase detector of claim 1, wherein said sampling phase detector includes a balanced output.

8. The phase detector of claim 7, wherein said balanced output of said sampling phase detector are respectively coupled to opposite ends of a potentiometer, wherein said phase error signal is generated at a wiper contact of said potentiometer.

9. A method of generating a phase error signal indicative of a phase difference between a reference signal and an oscillator signal, comprising:

converting said reference signal to a harmonic-rich signal having a rising and/or falling edge; and

generating said phase error signal from said harmonic-rich signal and said oscillator signal.

10. The method of claim 9, wherein said harmonic-rich signal is a substantially square-wave signal.

11. The method of claim 9, wherein converting said reference signal is performed by a saturated amplifier.

12. The method of claim 9, wherein converting said reference signal is performed by a first saturated amplification stage and a second saturated power amplification stage.

13. The method of claim 9, further comprising converting said harmonic-rich signal to first and second harmonic-rich signals cycling with substantially opposite phases.

14. The method of claim 13, wherein said phase error signal is generated from said first and second harmonic-rich signals.

15. The method of claim 9, wherein generating said phase error signal comprises:

generating first and second phase error signals having substantially opposite phases; and

adding respective weighted portions of said first and second phase error signals to generate said phase error signal.

16. The method of claim 15, wherein adding respective weighted portions of said first and second phase error signals is performed by a potentiometer.

17. A local oscillator, comprising:

a reference oscillator for generating a reference signal;

an oscillator for generating an oscillator signal; and

a phase detector for generating a phase error signal indicative of a phase difference between said reference signal and said oscillator signal, comprising:

an amplifier to convert said reference signal to a substantially square wave signal; and

a sampling phase detector to generate said phase error signal from said substantially square-wave signal and said oscillator signal.

18. The local oscillator of claim 17, wherein said amplifier comprises a saturated amplification stage.

19. The local oscillator of claim 17, wherein said amplifier comprises a first saturated amplification stage and a second saturated power amplification stage.

20. The local oscillator of claim 17, further comprising a transformer to convert a single output of said amplifier to a balanced output.

21. The local oscillator of claim 20, wherein said balanced output have impedances that substantially match the respective input impedances of said sampling phase detector.

22. The local oscillator of claim 17, wherein said sampling phase detector includes a balanced output.

23. The local oscillator of claim 22, wherein said balanced output of said sampling phase detector are respectively coupled to opposite ends of a potentiometer, wherein said phase error signal is generated at a wiper contact of said potentiometer.

24. The local oscillator of claim 17, wherein said oscillator comprises a dielectric resonator oscillator (DRO).

25. The local oscillator of claim 17, wherein said reference oscillator comprises a crystal oscillator.

26. A receiver or transmitter having at least one frequency conversion stage, wherein said frequency conversion stage comprises:

a mixer; and

a local oscillator for said mixer, comprising:

a reference oscillator for generating a reference signal;

an oscillator for generating an oscillator signal; and

a phase detector for generating a phase error signal indicative of a phase difference between said reference signal and said oscillator signal, comprising:

an amplifier to convert said reference signal to a substantially square wave signal; and

a sampling phase detector to generate said phase error signal from said substantially square-wave signal and said oscillator signal.

27. The receiver or transmitter of claim 26, wherein said amplifier comprises a saturated amplification stage.

28. The receiver or transmitter of claim 26, wherein said amplifier comprises a first saturated amplification stage and a second saturated power amplification stage.

29. The receiver or transmitter of claim 26, further comprising a transformer to convert a single output of said amplifier to a balanced output.

30. The receiver or transmitter of claim 29, wherein said balanced output have impedances that substantially match the respective input impedances of said sampling phase detector.

31. The receiver or transmitter of claim 26, wherein said sampling phase detector includes a balanced output.

32. The receiver or transmitter of claim 31, wherein said balanced output of said sampling phase detector are respectively coupled to opposite ends of a potentiometer, wherein said phase error signal is generated at a wiper contact of said potentiometer.

33. The receiver or transmitter of claim 26, wherein said oscillator comprises a dielectric resonator oscillator (DRO).

34. The receiver or transmitter of claim 26, wherein said reference oscillator comprises a crystal oscillator.